METHOD FOR PRODUCING LIGHT WEIGHT ULTRAFINE FIBER FABRIC

Background of the Invention

1. Field of the Invention

The present invention relates to a method for producing a light weight ultrafine fiber and a method for producing a light weight artificial leather and fabric from the light weight ultrafine fiber.

2. Description of the Related Art

Conventional methods for producing an artificial leather pertain to obtaining nonwoven substrate from a fiber obtained by spinning polymeric material and obtaining the artificial leather by subjecting the nonwoven substrate through a plurality of processing steps. To render the artificial leather being lighter than genuine leather or artificial leather made of conventional ultrafine fiber (artificial leather based on a substrate of polyamide ultrafine fiber or polyester ultrafine fiber), it is essential for the leather substrate to be light weight and the fiber from which the substrate is made to be thin so as to render the leather having genuine-like touch and fluff-like properties.

Taiwan Patent Application No. 79107562, entitled "METHOD FOR PRODUCING POLYURETHANE SYNTHESTIC LEATHER USING LIGHT WEIGHT POLYPROPYLENE NONWOVEN FABRIC AS A SUBSTRATE," discloses a method for producing leather substrates from polypropylene fiber ranging from 1 to 10 denier per filament. Although the leather thus obtained is lighter than conventional leather, it is not easy to produce artificial leather having genuine-like touch and fluff-like properties because the fiber used in the method is not sufficiently thin enough.

Taiwan Patent Application No. 78107985, entitled "GENUINE-LIKE COMPLEX ULTRAFINE FIBER NONWOVEN FABRIC," discloses a method

for producing leather substrates from an ultrafine fiber made from polyester or nylon materials. The artificial leather thus obtained has feel and surface feather similar to those of natural leather. However, these two fibers have density of 1.39 and 1.14 g/cm^3, respectively, which are 52.7% and 25.3% more than that of polypropylene (0.91 g/cm^3). Hence, the leather thus obtained is still heavy and does not meet the requirements.

Therefore, for the time being, there is a need for a ultrafine fiber having low density and high flexural modulus to be made into a substrate as material for producing an artificial leather or fabric having, in addition to genuine leather-like feel, considerably reduced weight when compared to conventional artificial leather.

Therefore, it is the purpose of the present invention to mitigate and/or obviate the drawbacks existing in the prior art in the manner set forth below.

Summary of the Invention

Accordingly, it is an object of this invention to provide a method for producing a light weight ultrafine fiber fabric by using sea and island ultrafine fiber.

It is an object of this invention to provide a method for producing a ultrafine fiber fabric having genuine-like touch a light weight fabric by using the light weight ultrafine fiber fabric.

In order to accomplish the above and other objects, an olefin polymer having a density less than 1.0 g/cm^3 and a flexural modulus more than 9000kg/cm^2 is used in the subject invention as an island polymer. A polymer having a different dissolving and removing property from that of the island polymer is used in the subject invention as a sea polymer. The density sets forth in the text of the subject invention refers to polymer density obtained by

ASTM-D792 at 25℃. The flexural modulus sets forth in the text of the subject invention refers to polymer flexural modulus obtained by ASTM-D790 at 23℃.

A method for producing sea and island ultrafine fiber in accordance with the subject invention mainly comprises spinning the island polymer and sea polymer to obtain a fiber. The spinning procedure in accordance with the subject invention comprises mixed spinning the island polymer and sea polymer in a weight ratio ranging from about 5:95 to 70:30 into the fiber or conjugate spinning the island polymer and sea polymer in a weight ratio ranging from about 5:95 to 95:5 into the fiber. The fiber thus obtained preferably has fineness ranging from about 1 to about 15 denier per filament and the number of the islands in the fiber preferably ranges from about 6 to about 5000. Suitable island polymer for the subject invention includes polypropylene, polyethylene, ethylene-propylene copolymer, and polyolefin elastomer polymer.

The polypropylene sets forth in the text of the subject invention refers to polypropylene homopolymer, polypropylene random copolymer, or polypropylene block copolymer.

The polyethylene sets forth in the text of the subject invention refers to low-density polyethylene, medium-density polyethylene, high-density polyethylene or linear low-density polyethylene polymer.

The materials suitable for the sea polymer of the subject invention can be selected from (a) solvent-soluble polymer (for example polystyrene and polyethylene), (b) alkali-soluble sulfonic sodium containing polyethyleneterephthalate and derivatives thereof, and (c) water-soluble polyvinyl alcohol or water-soluble polyester copolymer comprising isopropyl alcohol (IPA), terephthalic acid (TPA), acrylic acid (AA), sulfonic sodium salt (SIP), and polyethyleneglycol (PEG).

The method for producing an ultrafine fiber fabric in accordance of the subject invention mainly comprises producing a nonwoven fabric or fabric substrate from the above-mentioned sea and island ultrafine fiber and dissolving and removing the sea polymer of the substrate so as to obtain an ultrafine fiber substrate. The island polymer obtained from the selected polyolefin polymer has low density and high flexural modulus properties. With the same weight per area, the substrate of the subject invention is thicker than that of conventional substrates made of nylon or polyester fiber as an island polymer. Due to high flexural modulus property of the island polymer obtained from the selected polyolefin polymer, the thickness reducing ratio of the substrate obtained from dissolving and removing the sea polymer in accordance with the subject invention is less than that of the conventional substrates. Hence, the weight of the nonwoven fabric or fabric substrate in accordance with the subject invention can be considerably reduced. The desired thickness of the final products can still be obtained after dissolving and removing the sea polymer.

In case of using the above-mentioned substrate of the subject invention to produce an artificial leather, during the step of producing a substrate, a nonwoven substrate is obtained from the above-mentioned sea and island ultrafine fiber. The nonwoven substrate is immersed into a polymer (for example a solvent-soluble polyurethane resin or a water-soluble polyurethane resin). The sea polymer in the nonwoven substrate is removed and then a semi-finished artificial leather is obtained. The semi-finished artificial leather is dried and surface polished to obtain an artificial leather having genuine leather-like touch and light weight ultrafine fiber. It should be noted that when the sea polymer is the water-soluble polymer mentioned previously, the sea polymer of the substrate could be dissolved and removed simultaneously in a step of a water-washing step

contained in the step of immersing nonwoven substrate (for example immersing the substrate into a solvent-soluble polyurethane resin). In addition, the light weight ultrafine fiber fabric can be produced from obtaining common fabric, for example, weaving or knitting, from the sea and island ultrafine fiber and then dissolving removing the sea polymer from the fabric.

Detailed Description of the Preferred Embodiment

The subject invention provides a method for producing sea and island ultrafine fiber, characterized by selecting a polyolefin polymer having a density less than $1.0g/cm^3$ and flexural modulus more than $9000gk/cm^2$ as an island polymer and selecting a sea polymer having a different dissolving and removing property from that of the island polymer. The subject invention also provides a method for producing an ultrafine fiber substrate using the fiber obtained from the above-mentioned method and dissolving and removing the sea polymer of the substrate. The detailed descriptions with respect to the method for producing an ultrafine fiber are as follows:

Firstly, two polymers having different dissolving and removing properties are selected as an island polymer and a sea polymer for producing fibers. The island polymer for the subject invention can be selected from polyolefin polymers, for example, polypropylene, polyethylene, ethylene-propylene copolymer, and polyolefin Eastover polymer. The materials suitable for the sea polymer of the subject invention can be selected from the following three polymers. The first polymer is an organic solvent (for example toluene)-soluble polyolefin polymer, for example polystyrene and polyethylene. The second polymer is an alkali (for example sodium hydroxide)-soluble polyester polymer, for example sulfonic sodium containing polyethyleneterephthalate and derivatives thereof (optionally with at least one component, for example para-terephthalic acid, aliphatic

dicarboxylic acid, aromatic dicarboxylic acid, aliphatic diol, aromatic diol, carboxylic acid or derivatives thereof). The third polymer is a water-soluble polyvinyl alcohol or water-soluble polyester copolymer comprising isopropyl alcohol (IPA), terephthalic acid (TPA), acrylic acid (AA), sulfonic sodium salt (SIP), and polyethyleneglycol.

Then, the island polymer and sea polymer are spun into yarns by a mixed spinning method or a conjugate spinning method. The so-called mixed spinning method pertains to mixing the sea polymer and island polymer, melting the polymers in the same extruder, and extruding the polymers through a spinneret to produce yarns. The so-called conjugate spinning method pertains to mixing and melting the sea polymer and island polymer in different extruders and combining the two polymers at a spinneret as yarns. In case of producing fiber by the mixed spinning method in accordance with the subject invention, the mixing weight ratio of the island polymer and sea polymer ranges from about 5:95 to 70:30. In case of producing fiber by the conjugate method in accordance with the subject invention, the mixing weight ratio of the island polymer and sea polymer ranges from about 5:95 to about 95:5. The number of the island present in the fiber obtained by the mixed spinning method ranges from about 100 to about 5000 while the number of the islands present in the fiber obtained by the conjugate method ranges from about 6 to 1000.

Details of the method for producing the ultrafine fiber substrate are as follows.

A nonwoven or woven substrate is produced from the ultrafine fiber produced in the previously mentioned method. In case of obtaining a nonwoven from the above-mentioned fiber, undrawn yarns (UDY) of about 3 to 30 denier per filament are obtained from the above two spinning methods and are stretched,

crimped and lubricated with oils to produce staple fiber having a fineness about 1 to about 15 denier per filament. Then, the staple filaments are opened, carded, crosslapped, and punched by needle (or water-jet) to produce a nonwoven substrate. In case of obtaining a woven fabric from the above-mentioned fiber, undrawn yarns (UDY) are produced from the above two spinning methods and are drawn, textured yarned to produce filaments. Then, the filaments are weaved intro a woven substrate.

A ultrafine fiber substrate can be obtained by removing the sea polymer in the substrate from the above methods. The island polymer is removed and only sea polymer remains. Hence, the fineness of the fiber in the substrate ranges from about 0.001 to about 0.5 denier per filament. The substrate relates to a ultrafine fiber substrate.

Due to the low-density property of the island polymer produced from polyolefin polymer, with the same weight per area, the substrate of the subject invention is thicker than that of conventional substrates made from nylon or polyester fiber. It should be noted that the island polymer is a polyolefin polymer having high flexural modulus. After removing the sea polymer, the ultrafine fiber substrate still maintains a thickness substantially the same with that of the substrate. In accordance with the invention, the thickness of the substrate obtained from removing the sea polymer in accordance with the subject invention is substantially the same as those of the conventional substrates. Hence, the weight of the nonwoven or fabric substrate in accordance with the subject invention can be considerably reduced. The desired thickness and light weight of the final products can still be obtained after removing the sea polymer.

In accordance with an example of the invention, a light weight fabric substrate can be produced by removing the sea polymer in the above fabric

substrate. Firstly, the nonwoven substrate is immersed in a polymer (for example a solvent-soluble polyurethane resin), and then solidified and washed in water. Semi-finished artificial leather is obtained by dissolving and removing the sea polymer in the nonwoven substrate. After being dried, the semi-finished artificial leather was polished to have genuine-like touch. It should be noted that when polyvinyl alcohol or the other water-soluble polymer is selected as a sea polymer, the water washing step and removing step of sea polymer can be simultaneously carried out with water of about 50 to 100 ℃. In this case, in addition to simplifying the preparation, the use of organic solvents is avoided so that the environment would not be adversely influenced. Furthermore, if styrene is selected as a sea polymer, it can be removed by toluene. If polyethylene terephthalate containing a sulfonic sodium salt is selected as a sea polymer, it can be removed by sodium hydroxide solution. When compared with that polyvinyl alcohol can be removed by water, the removing process for selecting styrene or polyethylene terephthalate containing a sulfonic sodium salt as a sea polymer may possibly results in pollution.

The subject invention is illustrated in the following examples.

Example 1

Polypropylene ester pellets having a MI of 35g/10min (FORMOSA TAFFETA CO., LTD) and thermoplastic polyvinyl alcohol ester pellets (U.S. AIR PRODUCT AND CHEMICAL CO) having a MI of 15g/10min are mixed in 50:50 weight ratio, fed to extruders (temperature in sections 1 to 5 in the extruder are set at 170℃, 200℃, 220℃, 220℃, and 220℃) for mixing and melting, extruded under a spinneret at spinning temperature 220℃, an single hole output of 0.5g/min, and a rolling speed 300m/min to produce undrawn yarns having 15 denier per filament and about 1000 islands.

The undrawn yarns were stretched for 2.5 times through heating rollers at 70℃. The yarns were crimped, lubricated with oils, dried, and cut to produce fiberfill having a fineness of 6 denier per filament, 2.0g/den of strength, and 50% elongation.

The fiberfill thus obtained is subjected to the steps of opening, carding, crosslapping, needle-punch to produce a nonwoven substrate having 300g/m^2. The nonwoven substrate is immersed in a polyurethane resin, and then solidified, washed in water, dried to produce an ultrafine semi-finished artificial leather having polypropylene fiber. During water washing step, water is maintained at 90℃ to remove polyvinyl alcohol simultaneously. Then, an ultrafine fiber having a fineness of 0.002 denier is obtained. After being surface polished and lamination treatment, an ultrafine light weight artificial leather having a thickness of 1.2 mm is obtained.

Example 2

Polypropylene ester pellets having a MI of 5g/10min (FORMOSA TAFFETA CO., LTD) and polyethylene terephthalate containing a sulfonic sodium salt having a IV of 0.68 (Far Eastern Textile Ltd.) are fed into extruders for melting, respectively, and their weight ratio is adjusted in 70:30 by a gear pump. The polymer thus obtained is extruded under a conjugate sea type spinneret at spinning temperature 290℃, an single hole output of 1.0g/min, and a rolling speed 1000m/min to produce undrawn yarns having 9 denier per filament and about 37 islands.

The undrawn yarns were stretched for 3 times through heating rollers at 90℃ and a hot water tank at 80℃. The yarns were crimped, lubricated with oils, dried, and cut to produce fiberfill having a fineness of 3 denier per filament, 4.0g/den of strength, and 40% elongation.

The fiberfill thus obtained is subjected to the steps of opening, carding, cross lapping, needle-punch to produce a nonwoven substrate having 250g/m2. The nonwoven substrate is immersed in a polyamino resin, and then solidified. washed in water, dried, and removing polyethylene terephthalate containing a sulfonic sodium salt with sodium hydroxide about 30 min at 75℃ to produce a ultrafine semi-finished artificial leather having polypropylene fiber. Then, a ultrafine fiber having a finess of 0.07 denier is obtained. After being surface polished and lamination treatment, a ultrafine light weight artificial leather having a thickness of 1.0mm is obtained.

Comparative Examples

Polypropylene and nylon 6 are used as island polymers to produce artificial leather according to the method substantially the same as that of Example 1. The comparison is shown in Table 1.

Item	Island polymer	
	Propylene polymer	Nylon 6 polymer
Density (g/cm^3) (ASTM D-792, 23℃)	0.91	1.14
Flexural modulus (kg/cm^2) (ASTM D-790, 23℃)	13500	7500
Weight/area of nonwoven (g/m^2) (ASTM D-3776)	400	400
Substrate thickness (mm) (ASTM D-1777)	2.0	1.6
Leather thickness after removing sea polymer (mm)	1.85	1.3
Thickness reducing ratio	7.5	18.75

Table 1 shows that the density of polypropylene is less 25.3% than that of nylon 6. When the weight per area of the nonwoven substrate is 400 g/m^2, the

thickness of the polypropylene nonwoven substrate is more 0.4mm than that of nylon 6. In addition, the flexural modulus of polypropylene is larger than that of nylon 6. After reducing the amount of materials, the thickness reducing rate of polypropylene is only 7.5% while that of nylon 6 is up to 18.75%. If the weight of polypropylene nonwoven substrate is controlled at $280g/m^2$, the thickness of nonwoven substrate can be 1.4 mm. If the amount of material is reduced, a thickness of 1.3 mm can be achieved. The total weight of nonwoven substrate can be reduced by 30%. In this case, the desired thickness of the final products can be obtained after removing the sea polymers.

While the present invention has been explained in relation to its preferred embodiments and illustrated with various drawings, it is to be understood that the embodiments shown in the drawings are merely exemplary and that various modifications of the invention will be apparent to those skilled in the art upon reading this specification. Therefore, it is to be understood that the invention disclosed herein is intended to cover all such modifications as shall fall within the scope of the appended claims.